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RESEARCH ARTICLE

Impact of drought on agriculture in North Karnataka - An economic analysis

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ABSTRACT : Agriculture, in India, is strongly affected by two major hydro-meteorological disasters, namely drought and flood. As a result drought is considered as one of the biggest menace to agriculture among all weather related crisis. Keeping this in view present study was carried out to analyse the impact of drought on agriculture in North-Karnataka. Study was based on primary data collected using pretested schedule. Data was analysed using tabular analysis. Results of the study revealed that 97.50 per cent of the responded that drought cause's very high reduction in household income and it causes unemployment. Majority of respondents opinioned that population migration (37.50 %) and conflicts for water in the society (18.75 %) was very high due to drought. Drought had very high impact on some of the parameters such as declining in ground water level (85 %), created water scarcity (71.25 %), average temperature was increased (18.75 %) and degraded pasture (6.25 %). During normal year farmers were able to get 4.39 q, 3.16 q, 3.18 q, 8.28 q, 4.89 q, 3 q, 3.89 q, 10 q, 9.85 q, 4.55 q and 4.62 q of Jowar, Wheat, Bajra, maize, Tur, Greengram, Chickpea, Groundnut, Cotton, Sunflower and Safflower, respectively. But during drought years yield levels of the crops was less. About 74.28 per cent less yield was obtained in case of Bajra followed by 61.34 per cent reduction in Tur yield. In case of Belagavi district, farmers were able to get 53.26 per cent reduction in Jowar yield. Farmers were able to get 15.52 quintal and 12.11 quintals of maize during normal and drought years, respectively. Due to drought farmers were carried out double sowing. About 31.66 per cent and 20 per cent of the respondents were able to carry double sowing in Vijayapura and Belagavi districts, respectively. Majority of the farmers said that in order to overcome the drought they search for alternative source of income (71.25 %) and store the crops for future consumption (70 %). Other alternative preparative measures adopted by farmers are storing of crop residue for livestock, growing less water consuming crops, selling of some livestock's and migrated for alternative source of employment.

Key Words :
Drought, Vulnerability, Livelihood, Meteorological drought

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India is mainly an agricultural country. Agriculture being a means of livelihood of almost 58 per cent of the population in the country represents India's most important economic sector. Climate and Agriculture are inextricably linked. Climate change affects agriculture in a number of ways, including through changes in average temperatures, rainfall, climate extremes, changes in pests and diseases; changes in atmospheric carbon dioxide and ground-level ozone concentrations; changes in the nutritional quality of some foods; and changes in sea level. Impacts of climate change are adverse. Climate change will make monsoons unpredictable. As a result crop yield per hectare will be hit badly, causing food insecurity and loss of livelihood.

Agriculture, in India, is strongly affected by two major hydro-meteorological disasters, namely drought and flood. Indian agriculture is heavily dependent on the monsoon as a source of water. Over 68-70 per cent of total sown are India is vulnerable to drought. In some parts of India, the failure of the monsoons result in water shortages, resulting in below-average crop yields. This is particularly true of major drought-prone regions such as southern and eastern Maharashtra, Northern Karnataka, Andhra Pradesh, Orissa, Gujarat, and Rajasthan.

As a result drought is considered as one of the biggest menace to agriculture among all weather related crisis. Rathore (2005) mentioned that the concept of drought varies from place to place depending upon normal climatic conditions, available water resources, agricultural practices and the various socio-economic activities of a region. The National Commission on Agriculture (NCA) in India defines three types of droughts, namely meteorological, agricultural and hydrological droughts. Agriculture drought occurs when soil moisture and rainfall are inadequate during the growing season to support healthy crop growth to maturity and causes crop stress and wilting. Parmar *et al.*, 2005 reported that agricultural drought is probably the most important aspect of drought, but that problem is more specialized and complicated than some investigators seem to realize. The agricultural drought, that is the non-availability of water for normal crop growth is more acute in arid, semi-arid and dry sub humid regions. These regions constitute nearly 77 per cent of the total land area in India and are consequently more prone to land degradation and frequent droughts. Past records indicate that in almost every year one part or other of the country has been subjected to drought, flood or cyclone.

The major drought years in India were 1877, 1899, 1918, 1972, 1987 and 2002. Over 68 per cent of India is vulnerable to drought. The 'chronically drought-prone areas is around 33 per cent which receive less than 750 mm of rainfall, while 35 per cent classified as 'drought-prone' receive a rainfall of 750-1,125 mm. The drought-prone areas of the country are confined to peninsular and western India – primarily arid, semi-arid and sub-humid regions. An analysis of 100 years of rainfall data reveals that the frequency of 'below-normal rainfall' in arid, semi- arid and sub-humid regions is 54-57 per cent, while severe and rare droughts occurred once every eight to nine years in arid and semi-arid zones. In these zones, rare droughts of severe intensity occurred once in 32 years, with almost every third year being a drought year. The 2002 monsoon was one of the shortest in recorded history. No other drought in the past led to such a drop in food production as the 2002 drought. Food grain production dipped by 29 million tonnes from 183 million tonnes. Production of rice fell drastically to 75.72 million tonnes (2002-03) as against 93.08 million tonnes during the previous year. Pulses fell to a level of 11.31 million tonnes. As for a commercial crops, production of oilseeds declined by 13.7 per cent during the 2002-03 *Rabi* season. Cotton and sugarcane also recorded negative growths of 7.7 and 7.2 per cent, respectively. The impact of the drought of 2002-03 on hydroelectric power generation led to a decline of 13.9 per cent. The percentage reduction in power generation is the maximum when compared with the drought years of the recent past (Anonymous, 2008).

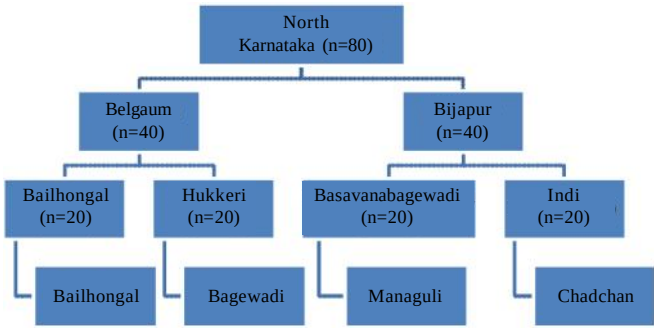
Karnataka experienced a severe drought for three consecutive years (2001-02, 2002-03 and 2003-04) and 159 taluks/blocks were listed as drought affected. During these periods, the state received 23 per cent of less rainfall (Biradar and Sridhar, 2009). The agricultural production declined to 64 lakh tonnes against the target of 104.05 lakh tones and the availability of crop residues for livestock was substantially low (Anonymous, 2003). The intensive drought had put most of the farmers in the state to the precarious situation leading to the migration to the nearby towns and cities. Keeping all this in view present study was undertaken to analyze the impact of drought on agriculture in North Karnataka.

EXPERIMENTAL METHODOLOGY

Study was based on primary data for the year 2014-15 was collected using well structured schedule. Purposive sampling technique was followed to collect the data. In order to analyze the impact of drought in North Karnataka, Bijapur and Belgaum were selected, since these two districts experienced higher negative deviation in rainfall during 2014-15. Agriculture area affected due to drought was more in Basavanabagewadi (32795 ha) and Indi (58212 ha) (Table A) so these taluks were selected from Bijapur district and Bailhongal and Hukkeri from Belgaum district. Results of the study were analyzed using tabular analysis.

Table A : District wise deviation in rainfall pattern in North-Karnataka

Sr. No.	Districts	Rainfall (mm)	% Deviation
1.	Bagalkote	430	-26
2.	Belgaum	561	-37
3.	Bellary	635	-6
4.	Bidar	585	-33
5.	Bijapur	398	-38
6.	Dharwad	564	-29
7.	Gadag	455	-31
8.	Gulbarga	551	-32
9.	Haveri	604	-23
10.	Koppal	512	-15
11.	Raichur	462	-30
12.	Uttara kannada	2106	-24
13.	Yadgir	509	-36



EXPERIMENTAL FINDINGS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Impact of drought on socio-economic characters of farmers :

Various Likert type responses related to socio-economic impacts of drought perceived by farmers are fixed and their opinion are documented and presented in Table 1. About 97.50 per cent of the respondents have answered that drought cause's very high reduction in household income and it causes unemployment (86.25 %). About 37.50 per cent and 18.75 per cent of the respondents opinioned that population migration and conflicts for water in the society was very high due to drought. Many people will flee a drought-stricken area in search of a new home with a better supply of water, enough food, and without the disease and conflict that were present in the place they are leaving (Hasnat *et al.*, 2014). Nearly 54 per cent of Respondents reported medium (67.50 %) to less (31.25 %) reduction in their expenses on festival celebrations. About 60 per cent of respondents reported high (40.00 %) to medium (60.00%) food scarcity during the drought years as compared to the normal years and 26.25 per cent of respondents said that drought highly threatened their household food security. Approximately 71.25 per cent and 21.25 per cent of respondents agreed that they have medium to less food grain choices for their daily consumption (Edwards *et al.*, 2008).

These economic impacts resulted into social, health and psychological impacts on farming livelihoods. It involved impacts such as inequities in the distribution of water or conflicts between water users, population migration and poor health. Table 1 shows that about 18.75, 37.50 and 5.00 per cent respondents rated these impacts to high to a very high extent, respectively. About 73.75, 71.25, 67.50, 63.75, 60 and 48.75 per cent of the respondents answered that drought threatened household food security, caused no choice in food preferences, reduced in spending on festivals, affected schooling of children, caused food scarcity and affected on health to a medium extent. These results were in line with results obtained from Udmale *et al.*, 2014. They were discussed that impacts are commonly referred to as direct and indirect. Many economic impacts occur in agriculture and related sectors, because of the reliance of these sectors on surface and groundwater supplies. In addition to losses in yields in both crop and livestock production, Income loss is another indicator used in assessing the impacts of drought. Reduced income for farmers has a ripple effect. Prices for food, energy, and other products increase as supplies are reduced. In some cases, local shortages of certain goods result in importing these goods from outside the drought-stricken region.

Environmental impacts of drought in North Karnataka :

Perception of farmers about impact of drought on environment is presented in Table 2. Drought had very high impact on some of the parameters such as declining in ground water level (85 %), created water scarcity (71.25 %), average temperature was increased (18.75 %) and degraded pasture (6.25 %). About 18.75 per cent and 57.50 per cent of the respondents said that drought

had high and medium impact on forest degradation, respectively. Deterioration in water quality (55 %) was high due to drought as answered by respondents. Drought had medium impact on wild life and fish habitat (68.75 %) in the study area. In addition to the economy, drought also affects the environment and society. Wildlife habitat, for example, may be degraded through the loss of wetlands, lakes and vegetation. However, many species eventually recover from this temporary aberration. The degradation of landscape quality, including increased soil erosion, may lead to a more permanent loss of biological productivity.

Impact of drought on crop yield :

Impact of drought on crop yield is presented in Table 3. The drought need not be a lengthier one even a dry spell during the critical growth period as short drought can cause significant damage and harm local economy. Production loss which is often used as a measure of the cost of drought is only a part of the overall economic cost. Average yield of the major crops during normal and drought years in Belagavi and Vijayapur districts are presented. During normal year farmers were able to get 4.39 q, 3.16 q, 3.18 q, 8.28 q, 4.89 q, 3 q, 3.89 q, 10 q, 9.85 q, 4.55 q and 4.62 q of jowar, wheat, bajra, maize, tur, greengram, chickpea, groundnut, cotton, sunflower and safflower, respectively. But during drought years yield levels of the crops was less. About 74.28 per cent less yield was obtained in case of bajra followed by 61.34 per cent reduction in tur yield. In case of Belagavi district, farmers were able to get 53.26 per cent reduction in Jowar yield. Farmers were able to get 15.52 quintal and 12.11 quintals of maize during normal and drought years, respectively. The difference in yield level was 78.03 per cent in case of maize.

Yield difference during drought and normal years in case of chickpea was 70.45 per cent. During normal years farmers were able to get 3.98 quintals of chickpea were as during drought years they got 2.81q. About 91.23 per cent reduction in yield level was observed in case of sugarcane. In case of groundnut and safflower farmers were able to get 73.21 per cent and 82.52 per cent less

Table 1 : Impact of drought on socio-economic characters of farmers **(n=80)**

Impacts	Very high	High	Medium	Less	Very less
Drought threatened household food security	0 (0.00)	21 (26.25)	59 (73.75)	0 (0.00)	0 (0.00)
Drought has caused food scarcity	0 (0.00)	32 (40.00)	48 (60.00)	0 (0.00)	0 (0.00)
Drought caused no choice in food preferences	1 (1.25)	5 (6.25)	57 (71.25)	17 (21.25)	0 (0.00)
Drought caused malnutrition	0 (0.00)	3 (3.75)	31 (38.75)	46 (57.50)	0 (0.00)
Drought affected on health	4 (5.00)	0 (0.00)	39 (48.75)	37 (46.25)	0 (0.00)
Drought caused unemployment	69 (86.25)	9 (11.25)	2 (2.50)	0 (0.00)	0 (0.00)
Drought caused reduction in household income	78 (97.50)	2 (2.50)	0 (0.00)	0 (0.00)	0 (0.00)
Drought caused reduction in spending on festivals	0 (0.00)	1 (1.25)	54 (67.50)	25 (31.25)	0 (0.00)
Drought caused population migration	30 (37.50)	47 (58.75)	3 (3.75)	0 (0.00)	0 (0.00)
Drought affected schooling of children	0 (0.00)	4 (5.00)	51 (63.75)	25 (31.25)	0 (0.00)
Drought caused hopefulness and sense of loss	0 (0.00)	27 (33.75)	17 (21.25)	36 (45.00)	0 (0.00)
Drought caused conflict for water in society	15 (18.75)	49 (61.25)	16 (20.00)	0 (0.00)	0 (0.00)
Drought caused farmers suicide	0 (0.00)	4 (5.00)	28 (35.00)	48(60.00)	0 (0.00)

Table 2 : Environmental impacts of drought in North Karnataka **(n=80)**

Sr. No.	Environmental impacts	Very high	High	Medium	Less	Very less
1.	Increase in average temp	15 (18.75)	45 (56.25)	20 (25.00)	0 (0.00)	0 (0.00)
2.	Forest degradation	0 (0.00)	15 (18.75)	46 (57.50)	19 (23.75)	0 (0.00)
3.	Pasture degradation	5 (6.25)	36 (45.00)	38 (47.50)	1 (1.25)	0 (0.00)
4.	Water scarcity	57 (71.25)	23 (28.75)	0 (0.00)	0 (0.00)	0 (0.00)
5.	Decline in ground water level	68 (85.00)	12 (15.00)	0 (0.00)	0 (0.00)	0 (0.00)
6.	Deterioration in water quality	2 (2.50)	44 (55.00)	30 (37.50)	4 (5.00)	0 (0.00)
7.	Damage to wild life and fish habitat	0 (0.00)	19 (23.75)	55 (68.75)	6 (7.50)	0 (0.00)

Note : Figures in parenthesis indicate percentages

yield compare to normal years. Greengram yield during normal years was 3.36 quintals but due to drought farmers were able to get 69.42 per cent less yield. Similarly in case of wheat farmers were able to get 63.11 per cent less yield due to drought. It is evident from table that if there was moderate deviation in precipitation there will be high reduction in the yield of rainfed crops (Ashalatha *et al.*, 2012). Agricultural losses impact the income and purchasing power of farmers converting small and medium farmers into agricultural labourers resulting in an increase in unemployment. Consequently, farmers and farm workers tend to migrate to urban areas in search

Table 3 : Impact of drought on crop yield **(n=80)**

Crops	Vijayapura			Belgaum		
	Normal year	Drought year	% change	Normal year	Drought year	% change
Jowar	4.39	2.57	58.62	6.57	3.50	53.26
Wheat	3.16	1.70	53.68	4.06	2.56	63.11
Bajra	3.18	2.36	74.28	-	-	-
Maize	8.28	2.85	34.48	15.52	12.11	78.03
Tur	4.89	3.00	61.34	-	-	-
Greengram	3.00	1.75	58.33	3.36	2.33	69.42
Chickpea	3.89	2.09	53.53	3.98	2.81	70.57
Soybean	-	-	-	4.19	2.95	70.45
Groundnut	10.00	4.71	47.14	10.50	7.68	73.21
Cotton	9.85	3.00	30.43	5.62	3.96	70.55
Sunflower	4.55	1.78	39.02	-	-	-
Safflower	4.625	2.31	50.00	3.95	3.26	82.52
Sugarcane	-	-	-	39.72	36.24	91.23

Table 4 : Impact of drought on area sown and cost of sowing

Area		Vijayapura	Belgaum	Average
Land holding (acre)		11.13	13.325	12.23125
Normal year		11.03	11.25	11.14375
Drought year		9.38	8.1375	8.7625
% Change in area sown		14.95	27.67	21.36
Average cost of sowing		4250	3437.5	3843.75
No. of farmers underrating double sowing	Yes	19	12	15.5
	No	21	28	24.5
Cost of double sowing		1468.75	1300	1384.375

Table 5 : Drought preparedness measures adopted by farmers in North Karnataka **(n=80)**

Preparedness activities	No. of farmers	Percentage
Do nothing	6	7.50
Store crop harvest	56	70.00
Store crop residues for livestock	46	57.50
Save money	0	0.00
Migration for employment	9	11.25
Sell some livestock	27	33.75
Seek alternative source of income	57	71.25
Selecting less water consuming crops	36	45.00
Early sowing	0	0.00

of employment opportunities (Rathore *et al.*, 2014).

Impacts of drought on area sown and cost of sowing is presented in Table 4. Average land holding in Vijayapur was 11.13 acres were as in case of Belagavi it was 13.32 acre. Average land holding in North Karnataka was 12.23 acre. During normal year farmers were able to cultivate 11.03 acre and 11.25 acre in Vijayapur and Belagavi, respectively. But due to drought farmers were able to sow only 9.38 acre and 8.13 acre of area. Agricultural drought is characterized by deficiency in water availability including soil moisture for specific agricultural operations (Nagaratna and Sridhar, 2009). Farmers were not able to sow 14.95 and 27.67 per cent of area in Vijayapura and Belagavi district, respectively due to drought.

Average cost of sowing was Rs. 4250 and Rs. 3437 in case of Vijayapura and Belagavi district, respectively. Due to drought farmers were carried out double sowing. About 31.66 per cent and 20 per cent of the respondents were able to carry double sowing in Vijayapura and Belagavi district. Cost of double sowing was Rs. 1468.75 and Rs.1300 in case of Vijayapura and Belagavi district, respectively. This additional cost was able to reduce the net returns and quality of the produce due to delay in sowing (Nagaraja, 2003). Average cost of double sowing due to drought in North Karnataka was Rs.1384.37.

Drought preparedness measures adopted by farmers in North Karnataka :

A drought preparedness measure adopted by farmers in North Karnataka is presented in Table 5. Majority of the farmers said in order to overcome the drought they search for alternative source of income (71.25 %) and store the crops for future consumption (70 %). Other alternative preparative measures adopted by farmers to overcome the negative impacts of drought are storing of crop residue for livestock (57.50 %), growing less water consuming crops (45 %), selling of some livestock's (33.75%) and migrated for alternative source of employment (11.25 %). These results were same as results discusses in Natural Disaster Management Guidelines 2010. Considering the increase in frequency of droughts in different parts of the country, it is necessary that there is a shift in public policy from drought relief to drought preparedness and mitigation measures. Most of these measures are related to integrated soil, water and forest management and form part of soil conservation, watershed development and forestry programmes. Drought proofing measures are taken before the crop is planted and drought management measures are taken during the crop growing period including *in situ* conservation, reduction in plant population, supplemental irrigation etc.

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